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BRIEFING ON THE EFFECTS OF THE PROTECTIVE MASK ON
INDIVIDUAL COMBAT SKILLS

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by

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Briefing for the U.S. Continental Army Command

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The immediate and prolonged effects of wearing a protective mask on an individual soldier's combat skills were studied in relation to seven different types of performance--rifle speed, obstacle running speed, clear running speed, rifle hits, binocular target detection, unaided target detection, radio, and driving vigilance. For each activity, one or more objective job-sample tests were constructed or existing tests (Continued)		

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20. ABSTRACT (Cont.)

modified and administered in two separate exploratory studies. Results of the study conducted at Fort Benning, Georgia with two groups of ten men each indicate (a) the immediate effect of the mask was interference with the combat activities, and (b) men did better, on the average, after they had worn the mask for five hours than they did after five hours unmasked.

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BRIEFING ON THE EFFECTS OF THE PROTECTIVE MASK ON
INDIVIDUAL COMBAT SKILLS

INTRODUCTION:

I am glad to be with you today to present this information briefing on Task PROTECT. Task PROTECT, as you know, is an approved R and D research task, sponsored jointly by the U. S. Army Chemical Corps Board and by Combat Developments, CONARC.

MISSION.

The mission of Task PROTECT is to measure the effects produced upon the individual soldier's combat skills when he is required to wear the protective mask. The Task is primarily concerned with the type of individual skills expected to be important in the combat operations of the Army in the time period 1960-1965. The Task is also concerned with determining the feasibility of reducing any loss in skill due to masking, either by means of training research or by modifications of the mask itself. Notice that this task deals with individual skills; our results would not necessarily apply directly to the operations of entire platoons or larger units.

MILITARY REQUIREMENT.

The military requirement for this research is specified in the Combat Development Objectives Guide, 1956, Paragraph 1240a. In future warfare, front-line units may be frequently subjected to attack by CBR agents. Anticipating a situation in which most front-line units would be forced to wear the protective mask for relatively extended periods, the Army approved this research, which is concerned with answering such questions as:

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What are the immediate effects of masking? That is, what effects occur within the first hour after putting on the mask?

What are the prolonged effects of masking? That is, what effects occur after the mask has been worn for five hours?

Which combat activities are seriously impaired by masking?

How can such impairments be reduced?

RELATION TO JACKPOT.

Those of you who are familiar with The Chemical Corps' JACKPOT operation will no doubt see a similarity in purpose between that study and this. Both studies are concerned with evaluating the effects of masking upon combat performance. HumRRO was asked to participate in the measurement problem, and it was decided that while JACKPOT concentrated on the large scale troop-testing of men operating as a military unit, HumRRO would concentrate on the intensive measurement of a small sample of soldiers, taken as individuals.

THE THREE STUDIES.

On Task PROTECT, three separate exploratory studies have been conducted. The first study was conducted at Dugway Proving Ground at Utah in May of this year. The second was conducted at the same location in June. The third study was conducted at Fort Benning, Georgia in August, and was based upon troops from the 2nd Infantry Division. Of the three, the Fort Benning study is considered the most dependable. It is based on larger samples of men, and the men had had more experience on the particular activities we tested. Furthermore, at Benning the troops were given preliminary training and familiarization, where deemed necessary, on the general kinds of activities to be tested. The Fort Benning study

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utilized tests which were much more combat-realistic, such as the TRAINFIRE firing ranges. Also during the Fort Benning study the actual testing was conducted by the Infantry Human Research Unit, a group highly experienced in the conduct of infantry field experiments.

For such reasons, the data presented in this briefing will be drawn mainly from the Fort Benning study. The only exceptions are for two selected tests which were conducted on the second visit to Dugway Proving Ground. No data from the first visit to Dugway will be reported.

MASK USED:

The candidate protective mask, E13 R9, was used in the studies being reported.

THE SKILLS AND THE TESTS.

The effects of masking were studied in relation to each of seven different types of performance that individual soldiers engage in during combat. These behaviors were selected on the basis of discussions between the researchers and experienced military personnel. These seven general types of military activities were:

Maintaining vigilance while driving a vehicle.

Communicating by radio.

Detecting human targets by unaided vision.

Detecting human targets with optical assistance.

Firing shoulder weapons.

Running cross-country.

Communicating by unaided voice.

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For each activity, one or more objective job-sample tests were constructed or existing tests were modified. Alternate forms of each test were built where practice effects were feared. These tests are realistic, and were judged by military experts to have validity.

In combat, men often have to drive wheeled vehicles. It is important that they keep alert to such things as road signs, to enemy and friendly personnel and equipment, and indeed to any significant objects located along the route. To measure this ability, the Driving Vigilance Test was conducted at Dugway Proving Ground. This test required a man to drive a quarter-ton vehicle at moderate speed for a distance of one mile along a rough winding desert trail and to call out to the scorer sitting beside him whenever he saw any man-made object. The objects hidden in the brush along the road consisted of such things as steel helmets, silhouette targets, shelter halves, paste board cartons, wooden crates, and so forth. The man's score was the total number of objects sighted.

In combat, men frequently have to transmit messages by radio. The radio test required a man to listen to twenty-five single word messages radioed to him by another man and to write down the appropriate letter for each, for example, B for BRAVO. The model radio used was the AN/PRC-6 (Handy talky). The listener's score was the total number of messages correctly received.

Combat soldiers often have to use their eyes to detect targets hidden in the terrain to their front. The TRAINFIRE Target Detection Test, which utilizes trained live target personnel, was used to measure this important skill.

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Men also use binoculars to detect targets in combat. The Binocular Target Detection Test, modeled after the TRAINFIRE procedure but utilizing greater ranges, was used to measure this activity.

Firing shoulder weapons is, of course, a common combat activity. Two rifle firing tests were used to measure different aspects of this critical skill. One test, conducted at Dugway, measured how many seconds were required for the man to fire at a target, once the target was designated; that is, his speed in getting off the aimed shot. The other test used the TRAINFIRE rifle range at Fort Benning which is designated to measure ability to hit pop-up targets exposed for only a few seconds. The TRAINFIRE test was scored in total number of targets hit.

Combat sometimes requires soldiers to run cross-country. In open terrain, a slow running soldier is more likely to become a casualty than is a fast runner. Both speed in running across open or clear terrain, and speed in running across obstructed terrain were used. Each of these running tests was two hundred and twenty yards long, or an eighth of a mile.

In combat, men communicate with one another by shouting messages. The squad leaders' or platoon leaders' commands cannot be obeyed if they cannot be heard. The Voice Commands Test measures the ability of men to hear short commands or short messages when transmitted by sheer lung power from distances of thirty, sixty and ninety yards.

Notice that these tests cover a wide range of types of physical activity. Some require delicate hand-eye coordination (for example, rifle marksmanship); others require strenuous work (for example, running across obstructed terrain for two hundred and twenty yards); others require primarily visual and interpretive skills (for example, target detection); others require speaking or shouting abilities (for example, radio and voice communication.)

Each of these tests was administered to troops when they were unmasked and also while they wore the E13 protective mask.

EXPERIMENTAL DESIGN.

The design of the research is diagrammed on this slide.

EXPERIMENTAL DESIGN - To Estimate Immediate and Prolonged Effects of Masking

IMMEDIATE EFFECTS are based on AM comparisons.

PROLONGED EFFECTS are based on PM comparisons.

	DAY 1		DAY 2	
	AM	PM	AM	PM
MASKED	Group 1	Group 1	Group 2	Group 2
UNMASKED	Group 2	Group 2	Group 1	Group 1

1. Each man was tested four times, twice masked and twice unmasked.
 2. Each man served as his own control - repeated measurements (masked and unmasked) on same individuals.
-

The effects of masking were determined by comparing the score men attained while wearing the mask with the score these same men attained while not masked, both scores being taken under comparable conditions.

As shown in the slide, the total group of men to be tested was divided in half, designated Group 1 and Group 2. Let's follow Group 1. Group 1 put on their masks the morning of the first day and were then tested. They wore the masks all day (about five hours) except for a two-minute water-break every couple of hours and a twenty-minute lunch break at noon. At the end of the day they were tested again, before removing their masks. On the second day this group never wore the mask, but they were tested in the morning and in the afternoon, as before.

Meanwhile, the other group of men - Group 2 - had been following a counterbalanced schedule.

By pooling the results of both groups over both days, a purer estimate of the masking effects is obtained. The immediate effects of masking are based on AM comparisons. The prolonged effects of masking are based on PM comparisons.

CLIMATIC CONDITIONS.

As has been mentioned, most of the information to be reported was collected in Georgia in the month of August - a hot wet climate. Some data was collected at Dugway Proving Ground in June - a hot dry climate.

It would, of course, be hazardous to generalize from data collected in such climates and attempt to predict the masking effects that would be found in radically different climates - the arctic, for example.

POPULATIONS SAMPLED.

The men tested at Dugway Proving Ground were Chemical Corps Troops from a smoke-generator company. Most or all of these men had been taking part in the JACKPOT operation. We tested all available personnel at one time or another. We will report results on two groups, of ten men each, who took the Driving Vigilance and Rifle Firing Tests.

With regard to the Fort Benning sample, not only were all men drawn from the 2nd Infantry Division but Infantry riflemen were used for the TRAINFIRE Target Detection and TRAINFIRE Rifle Range tests, Communication troops were used for the Radio Test, and Tank Company personnel were used for the Binocular Target Detection test. That is, insofar as possible, personnel were selected who were already experienced on the various activities on which they were to be tested. The Fort Benning samples, then, should be typical of combat-ready troops.

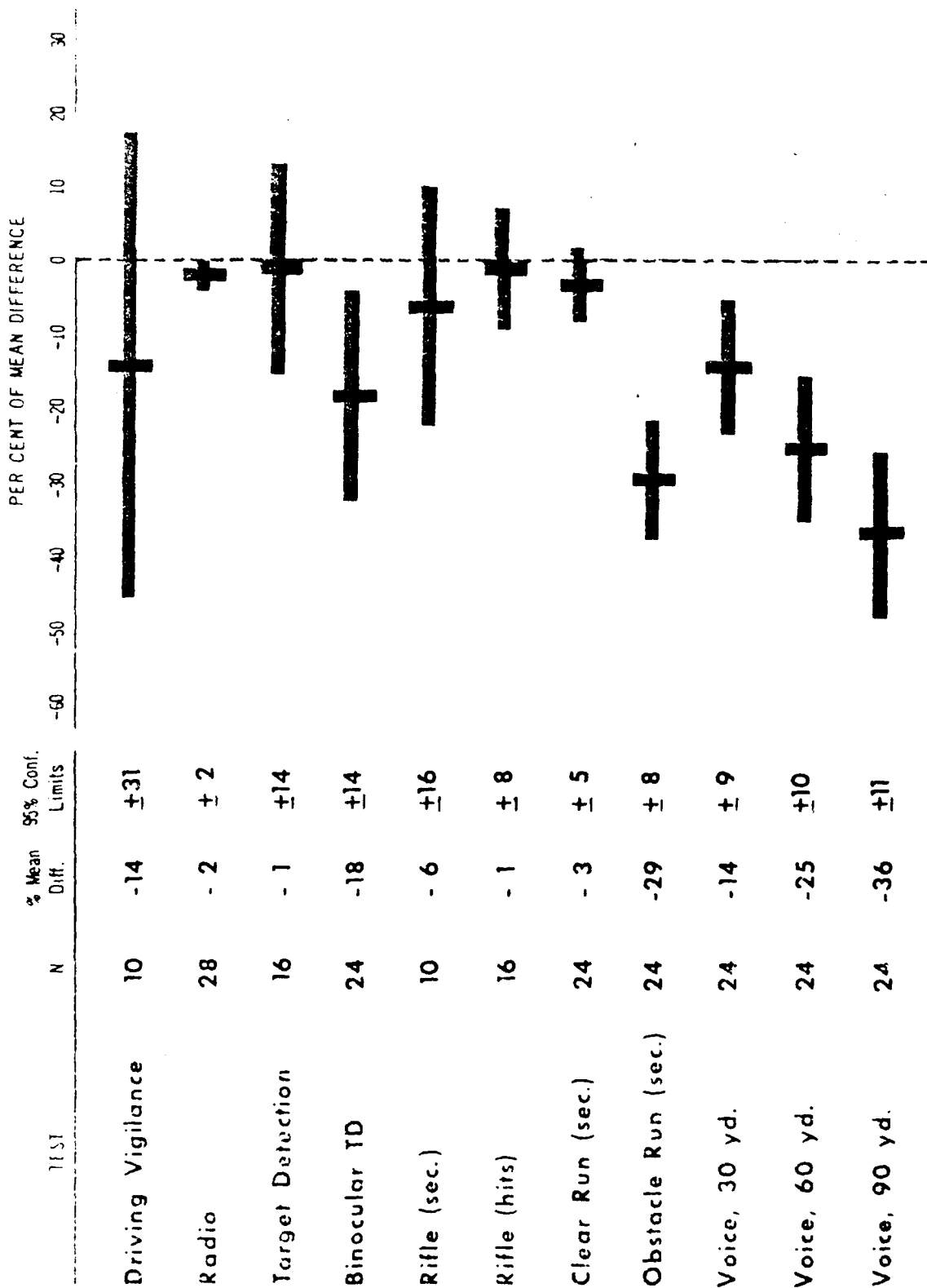
RESULTS.

Immediate Effects of Masking: Here are the results.

This slide shows the immediate effects of masking, the effects occurring within the first hour of wearing the protective mask. As you see, the various tests are listed down the left hand side. The number of men tested is shown for each. The per cent of the average difference, relative to the unmasked average score, is then listed, and this per cent is plotted on the scale to the right. Notice that all these differences are negative. This indicates loss or decrement, relative to the unmasked scores. On every test, wearing the mask is associated with lowered performance. Notice, however, that many of these differences are very slight. The Obstacle Running test and the Voice Commands Test at the bottom of the slide, show the largest losses.

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IMMEDIATE EFFECTS OF MASKING



Positive Differences
(Masked superior)

Negative Differences
(Masked inferior)

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The percentages I have read are based on averages; as such they are estimates of the decrements we would obtain if the study were repeated. If we had tested a much larger number of men we would have a much better estimate of the exact amount of decrement. With the small samples shown here, we have only rough estimates. Our measuring procedure was more of a crude yard-stick than a high-precision micrometer.

This overlay indicates how certain - or uncertain - we are about these decrements. The new column gives the ninety-five per cent confidence limits around each of the average decrements.

The horizontal bars picture these confidence limits. For example, the average loss on the Driving Vigilance test was fourteen per cent, but if this study were repeated several times, we would get several different averages. The confidence limits specify the range which we can be ninety-five per cent certain includes the true value, the real decrement - that is, between minus forty-five per cent and plus seventeen per cent in the case of the Driving Vigilance Test.

Notice that on the Driving Vigilance Test the horizontal bar overlaps the zero point, so we are not even very confident that there would be a loss in performance on this activity. Contrast the Driving Vigilance Test at the top of the slide, with the Voice Commands Test at the ninety-yard range, at the bottom. Here the horizontal bar falls far short of the zero point - accordingly, we are very confident that the mask does indeed interfere with voice communication.

All the results shown here are evidence that the mask interferes with all these combat activities. Sometimes the evidence is weak and the verdict might be "not proven". Sometimes the evidence is strong and we can feel confident that we are right in assuming that the mask does in fact interfere with the activity. If we had to bet - if we had to reach a decision on this evidence - we would bet on the averages. We would bet that the true effect is as indicated by the vertical bars.

Very well. We now know that the mask interferes with some activities. This is not surprising. But does the mask always tend to interfere, at least a little, with any activity? Could the opposite occur?

Are there any activities in which wearing the mask would actually improve performance?

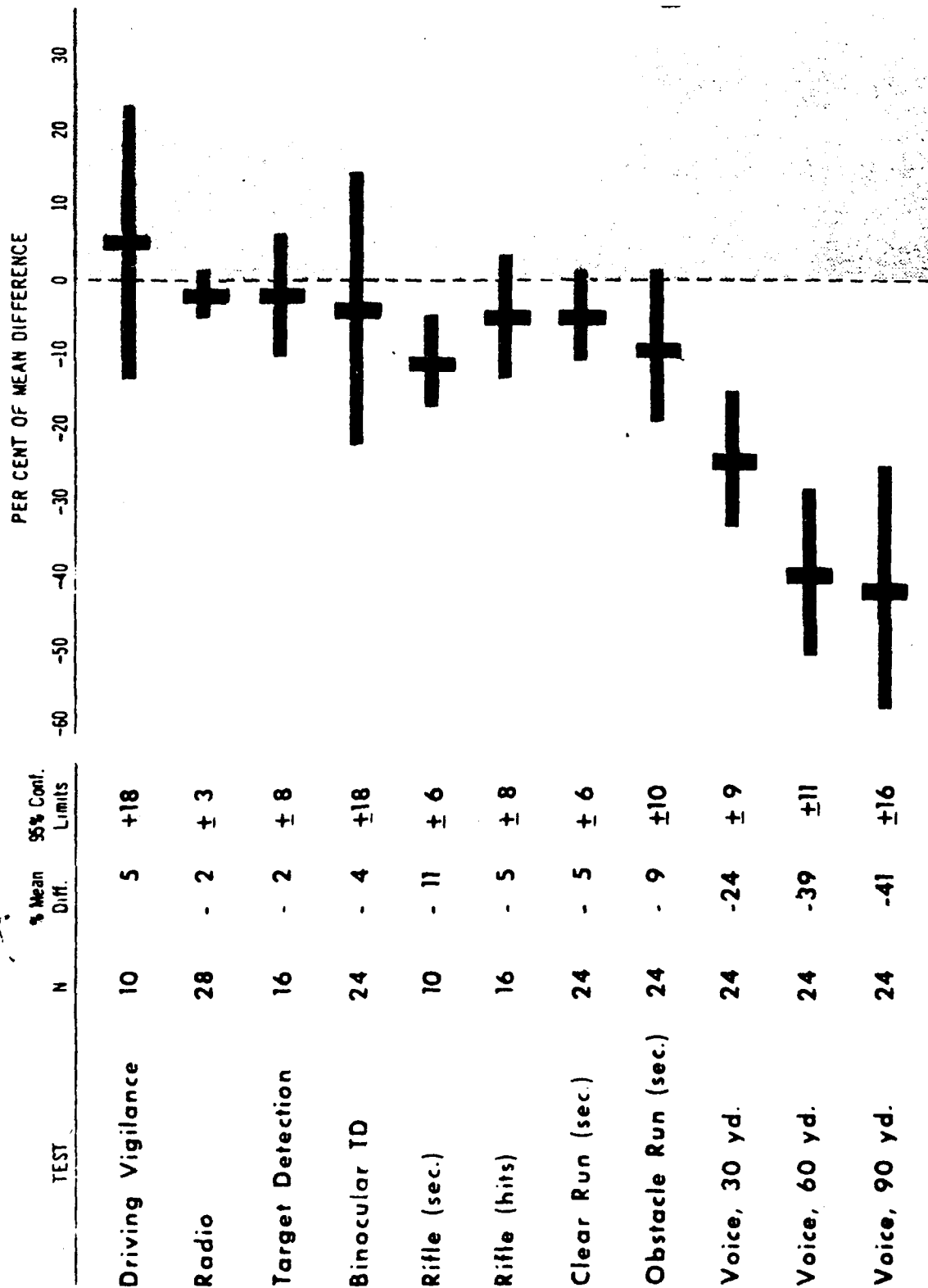
Our opinion is "yes, there probably are activities which a man can perform better when he wears the mask". For example, we would expect a masked observer to be superior to an unmasked observer in a situation in which both were required to face into a cutting freezing wind for several hours. The mask is protective mask in a broader sense than merely affording protection against CBR agents.

RESULTS:

Prolonged Effects of Masking: Now let's look at the prolonged effects of masking. Here are the average differences. Here are the confidence limits. The tests are in the same order as before. Notice that the first test, Driving Vigilance, now shows a five per cent increase in performance. The men we tested did better, on the average, after they had worn the mask

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PROLONGED EFFECTS OF MASKING



Negative Differences
(Masked inferior)

Positive Differences
(Masked superior)

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for five hours than they did after they had spent this time unmasked. Although the mask seems to have helped them this time, we don't believe that it would happen consistently if other samples of men were tested. We could be wrong; maybe, due to the large amount of dust stirred up by the vehicle, the mask does help men in this activity, and maybe the reason this result didn't show up on the other chart is because four or five hours of mask-wearing are required for the man to get used to the mask.

We just don't know. But since on both charts this is the only result giving evidence that the mask assists performance we would be inclined to discount this finding.

Let's look at the results on the other tests.

These prolonged effects of masking are probably of greater interest to military planners and training authorities than are the immediate effects. Either for combat operations or for training purposes, officers would usually be more interested in knowing how well a man will perform over some extended period - a period three hours, eight hours, or twelve hours long - than they would be in knowing how well a man can perform within the first few minutes of putting on the mask. Performance may get better or it may get worse but, whatever happens, these prolonged effect estimates should ordinarily provide the better planning figures.

CONCLUSION:

In the near future we must decide whether to continue this research on the influence of mask-wearing upon individual combat activities. We could continue by measuring the masking effects on other types of military activities - vehicle maintenance and repair, for example. Or, we could

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continue to work with these same combat activities and concentrate on finding ways of training troops so as to reduce decrements.

On the basis of the data you have seen, and on the basis of our experience in conducting these exploratory studies, we are inclined to believe that our research on this specific problem should be discontinued.

We feel this way because, except for voice communication, the prolonged average loss in our sample is never larger than eleven per cent.

Here are the figures again:

Rifle Speed: eleven per cent loss.

Obstacle running speed: nine per cent loss.

Clear running speed: five per cent.

Rifle hits: five per cent.

Binocular Target Detection: four per cent.

Unaided target detection: two per cent.

Radio: two per cent

Driving Vigilance: zero loss; in fact, a five per cent gain.

Only the Voice Commands test indicates large loss. At thirty, sixty and ninety yards the losses are, respectively, twenty-four per cent, thirty-nine per cent, and forty-one per cent. These are rather impressive losses. However, this problem of reducing mask decrement on individual combat skills does not seem to us to be a problem that should be attacked by means of training methods research. We see little hope of substantially reducing these decrements by means of special training techniques, consequently we believe that our training methods research on this problem should be discontinued.

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We request your thoughts on the matter.

We would also appreciate your guidance on the desirability of a different research effort, aimed at determining the overall loss in combat effectiveness of platoon or larger units when men wear full protective clothing under different climatic conditions. Thank you.

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